Chapter 3
WATER RESOURCES AND SYSTEM OVERVIEW

REGIONAL HYDROLOGIC CYCLE

The main components of the hydrologic cycle in the LWC Planning Area are precipitation (and the resulting infiltration); evapotranspiration (and the resulting withdrawal); surface water inflow and outflow; and ground water flow.

Precipitation and Evapotranspiration

The average annual precipitation in the LWC Planning Area is approximately 52 inches (**Figure 6**). Nearly two-thirds of the rainfall occurs during the six-month wet season from May through October. Much of this rainfall is returned to the atmosphere by plant transpiration or evaporation from soils and water surfaces. Hydrologic and meteorologic methods are available to measure and/or estimate the combined rate at which water is returned to the atmosphere by transpiration and evaporation. The combined processes are known as evapotranspiration (ET).

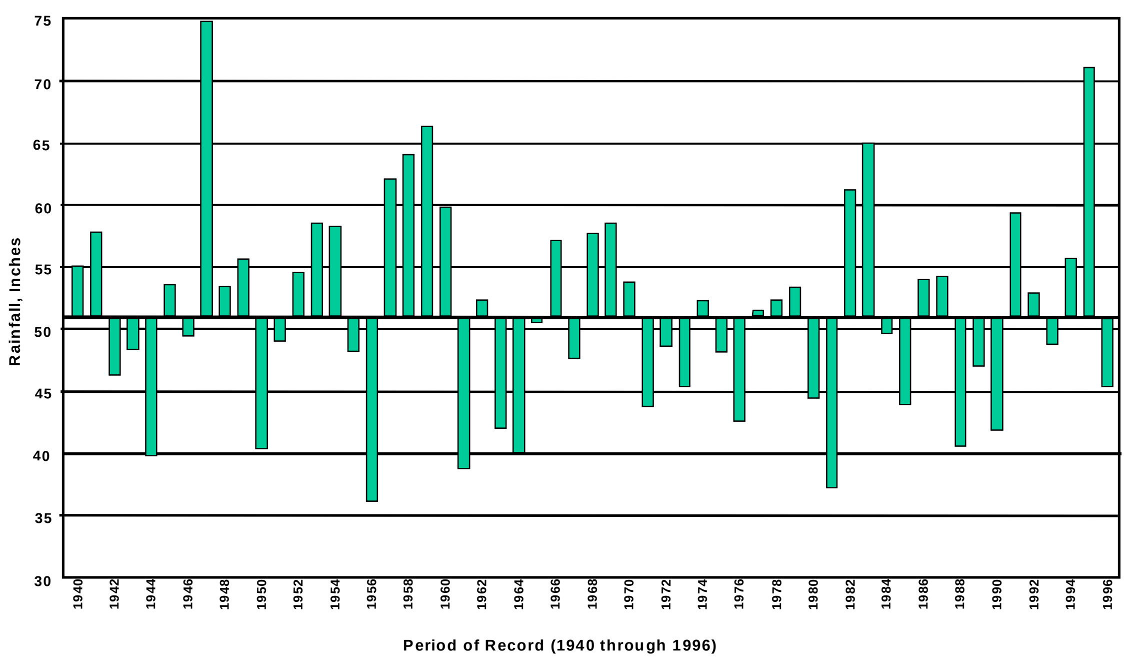


Figure 6. Variation from Annual Average Rainfall in the Lower West Coast Planning Area.

Evapotranspiration (ET), like rainfall, is generally expressed in inches per year. Approximately 45 inches of water per year is returned to the atmosphere by evapotranspiration in South Florida. The excess of average precipitation over average ET is equal to the combined amounts of average surface water runoff and average ground water recharge. Historical rainfall data and the results of a frequency analysis are presented in Appendix B.

Surface Water Inflow and Outflow

Most surface water in the LWC Planning Area is derived from rainfall. fhe exception to this is the Caloosahatchee River Canal (C-43), which also receives water from Lake Okeechobee. Historic flowways in the region were the natural drainage features consisting of a series of flat wetlands or swamps connected by shallow drainage ways or sloughs that were divided by low ridges. These features were dry for a portion of the year, and overtopped by water in periods of seasonal high rainfall (Nath, 1998). The majority of the canals in the LWC Planning Area were constructed as surface water drainage systems rather than for water supply purposes. The C-43 Canal is the only major canal used for water supply and it is maintained by releases from Lake Okeechobee. The amount of stored water is of critical importance to both the natural ecosystems and the developed areas in the LWC Planning Area. Management of surface water storage capacity involves balancing two conflicting conditions. When there is little water in storage, drought conditions may occur during periods of deficient rainfall. Conversely, when storage is at capacity, flooding may occur due to excessive rainfall, especially during the wet season. Improved management of surface water drainage systems could have an extensive affect on the movement of water through the regional hydrologic cycle.

Ground Water Flow

Three aquifer systems, the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS) and the Floridan Aquifer System (FAS), underlie the LWC Planning Area. Rainfall is the main source of recharge to the SAS. Ground water inflows from outside the LWC Planning Area from a much smaller portion of recharge to the SAS. The IAS is partially recharged from the SAS. The FAS receives its recharge from outside of the LWC Planning Area. Fairbank and Hohner (1995) present maps showing the spatial recharge rates into the SAS and the IAS.

SURFACE WATER RESOURCES

Prior to development, nearly level, poorly drained lands subject to frequent flooding characterized most of the LWC Planning Area. The natural surface drainage systems included large expanses of sloughs and marshes such as Telegraph Cypress Swamp, Corkscrew Swamp, Flint Pen Strand, Camp Keais Strand, Six Mile Cypress Slough, Okaloacoochee Slough and Twelve Mile Slough.

Lakes, Rivers, Canals, and Drainage Basins

Surface water bodies in the LWC Planning Area include lakes, rivers, and canals, which provide storage and conveyance of surface water. Lake Trafford and Lake

Hicpochee are the two largest lakes within the LWC Planning Area, but neither lake is considered a good source of water supply. **Plate 1** shows the lakes, rivers, canals and drainage basins (see below) in the LWC Planning Area.

The Caloosahatchee River is the most important source of surface water in the region and extends across seven of the ten drainage basins in the LWC Planning Area. The river is supplied by inflows from Lake Okeechobee and runoff from within its own basin. The freshwater portion of the river (C-43) extends eastward from the Franklin Lock and Dam (S-79) towards Lake Okeechobee and the cities of LaBelle and Moore Haven. West of S-79, the river mixes freely with estuarine water as it empties into the Gulf of Mexico.

The remaining rivers and canals in the LWC Planning Area drain either into Estero Bay, the Caloosahatchee River or the Gulf of Mexico. The majority of canals were constructed as surface water drainage systems rather than for water supply purposes. The C-43 Canal is the only major canal used for water supply and it is maintained by releases from Lake Okeechobee.

Drainage Basins

The LWC Planning Area is divided into 10 major drainage basins according to their respective hydrologic characteristics (**Plate 1**). These basins are the (1) North Coastal Basin, (2) Tidal Caloosahatchee Basin, (3) Telegraph Swamp Basin, (4) West Caloosahatchee Basin, (5) East Caloosahatchee Basin, (6) C-21 Basin, (7) S-236 Basin, (8) Estero Bay Basin, (9) West Collier Basin, and (10) East Collier Basin. The West Collier and East Collier basins have extensive wetland systems, which are described in Chapter 4 Natural Resources, in this document.

Some of the major rivers, and canals of the drainage basins have surface water bodies with regional water supply and include the Big Cypress Basin canal system and the Caloosahatchee River **(Figure 7)**. The LWC Planning Document (1994) recommended that the District identify opportunities to cooperatively evaluate the feasibility of using the Caloosahatchee River as a seasonal source of supply. The Caloosahatchee Water Management Plan (CWMP), completed in April 2000, addresses availability of water from the river. Recommendations from the CWMP are included in the 2000 LWC Water Supply Plan. Other regional recommendations in the 1994 LWC Planning Document include assisting Lee County in adopting the Lee County Surface Water Management Plan, which recommends increasing water supply within the county's basins; and working with public water suppliers and local governments in identifying additional sites for ASR projects.

North Coastal Basin

The North Coastal Basin is in southwestern Charlotte County and northwestern Lee County. There are numerous creeks within this basin. The basin drains via overland flow from the Fred C. Babcock/Cecil M. Webb Wildlife Management Area in Charlotte County into the Gator Slough watershed within northwestern Lee County. Most of this

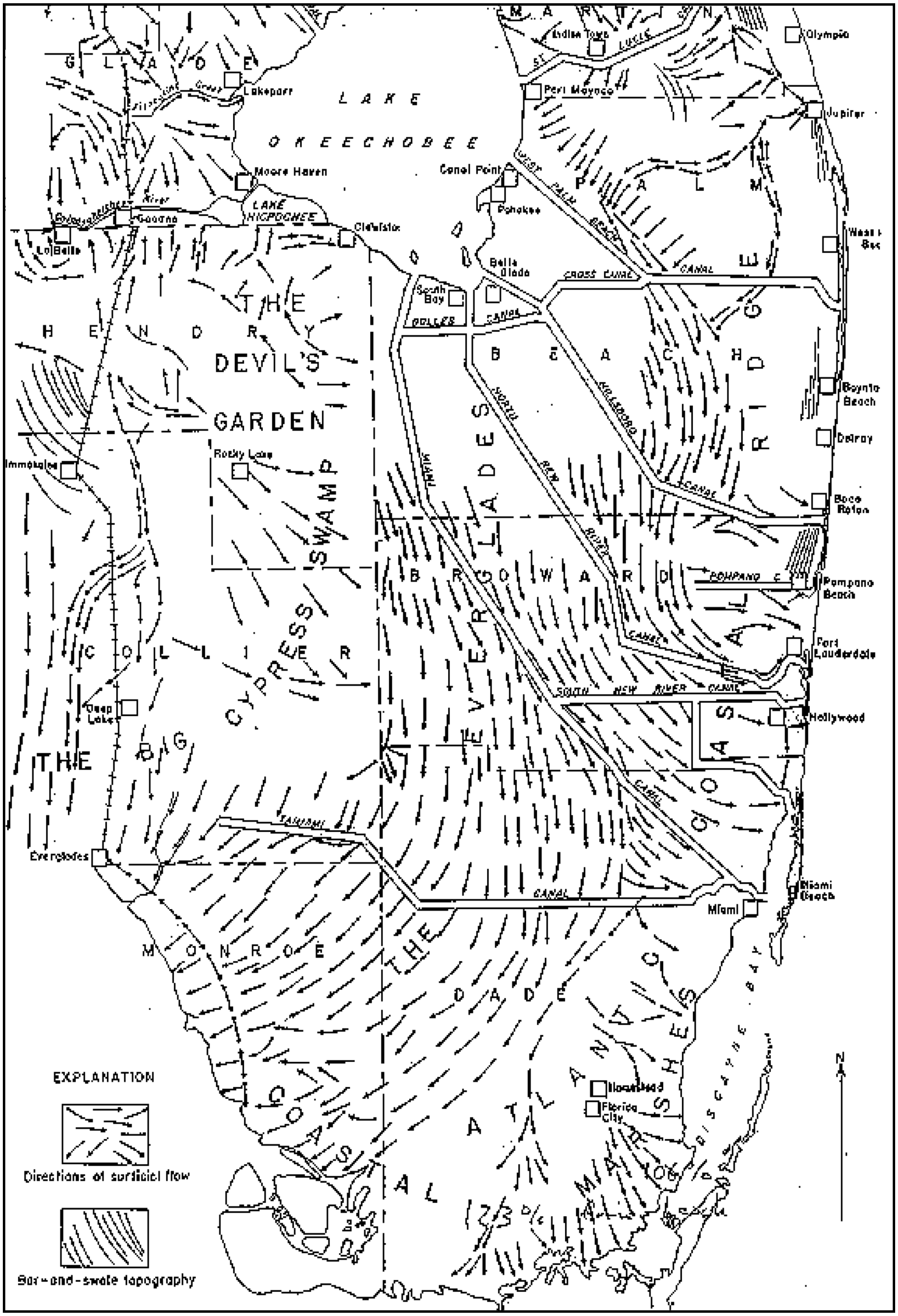


Figure 7. Historic Surface Water Drainage System in the South Florida (Parker, et. al, 1955).

basin drains through the Gator Slough Canal into the Cape Coral Canal System. Improvements were made in 1998 to divert water to Cape Coral for direct use or recharge.

Tidal Caloosahatchee Basin

The Tidal Caloosahatchee Basin extends on both sides of the saltwater portion of the Caloosahatchee Basin, northerly into Charlotte County. Numerous creeks drain into the Caloosahatchee River in this basin. These creeks are tidally influenced and are not currently suitable as a major source of surface water withdrawal. The Lee County Interim Surface Water Management Plan (Johnson Engineering et al., 1990) recommends putting weirs in several of the creeks to maintain water levels in the dry season. The report suggests that Trout Creek and the channelized portion of the Orange River have a potential for water supply. Trout Creek receives drainage from the Fred C. Babcock/Cecil M. Webb area via sheetflow and a large canal; placing a weir in the creek would enhance its water supply potential. In the Lehigh Acres area, the weirs in Able Canal (the channelized portion of the Orange River) provide recharge to the area. East County Water Control District is modifying internal weirs to retain more water on-site for ground water recharge.

Telegraph Swamp Basin

The Telegraph Swamp Basin extends from Charlotte County southward to the Caloosahatchee River. The major feature of this basin is the Telegraph Cypress Swamp which drains via sheetflow into Telegraph Creek in Lee County. Since this is a large watershed (approximately 92 square miles) with sheetflow discharge, there is a potential for this basin to be a good recharge area (Johnson Engineering et al., 1990).

West and East Caloosahatchee, C-21, and S-236 Basins

The West and East Caloosahatchee, C-21, and S-236 basins extend along the freshwater portion of the Caloosahatchee River (C-43 Canal), from S-79 (Franklin Lock and Dam) to S-77 at Lake Okeechobee. The basins include parts of Lee, Collier, Hendry, Glades, and Charlotte counties. The C-43 Canal is the major surface water resource within these basins. The primary purpose for the canal is to provide relief for regulatory releases of excess water from Lake Okeechobee. In the East Caloosahatchee Basin, Lake Hicpochee was severely impacted by the construction of the C-43 Canal. The canal was constructed through the lake's center, which resulted in lower lake water levels. The C-43 Canal provides drainage for numerous private drainage systems and local drainage districts within the combined drainage basins.

The C-43 Canal also provides water for agricultural irrigation projects within the basins and public water supply for the city of Fort Myers and Lee County. In 1998, the city of Fort Myers withdrew 8 MGD for the public water supply from the C-43, while approximately 3 MGD of the total public water supply of Lee County came from the C-43.

There are three structures (S-77, S-78 and S-79) which provide for navigation and water control in the C-43 Canal. These structures serve to control the water stages in C-43 from Lake Okeechobee (S-77) to Franklin Lock (S-79). Water levels upstream of S-78 are maintained at approximately 11 feet national geodetic vertical datum (NGVD), and 3 feet NGVD downstream. The S-79 Structure also serves as a saltwater barrier. The operation schedule for these structures is dependent on rainfall conditions, agricultural practices, the need for regulatory releases from Lake Okeechobee, and the need to provide water quality control for the public water supply facilities (SFWMD, 1987).

Estero Bay Basin

In the Estero Bay Basin in southern Lee County, there is a two-fold water management problem. Overdrainage is a problem in areas due to development. Conversely, lack of conveyance in other areas result in flooding. The basins include Hendry Creek, Mullock Creek/Ten Mile Canal/Six Mile Cypress Slough, Kehl Canal/ Imperial River, Estero River and Spring Creek. These waterways, with the exception of Ten Mile Canal and Kehl Canal, are all tidally influenced to some degree.

Several waterwork projects have been completed, or are underway, to increase water levels in the western part of the basin and to protect the water resources against saltwater intrusion (Hendry Creek has a saltwater barrier and weirs in Ten Mile Canal have been raised to increase the water levels within Six Mile Cypress Slough). Johnson Engineering (1990) concluded that the Estero Bay Basin does not have a major source of surface water available for water supply. However, because the basin has good recharge areas, saltwater barriers (weirs), could be used to increase water levels within the basin for recharge.

The Estero River east of U.S. 41 has slow conveyance and is considered a good recharge area, as is the Imperial River east of I-75. The Kehl Canal is connected to this river and drains the water levels within this basin in the dry season. The District and Lee County cost shared the replacement of the existing temporary Kehl Canal Weir, with a permanent structure containing two screw gates for water management. This weir increases water levels in the east Bonita area (a major recharge area). The new weir was designed to have the flexibility to add a cap to the weir structure to increase the water level to 12-13 feet NGVD for additional recharge capabilities in the area.

West Collier Basin

The West Collier Basin extends from State Road 29 westward to the Gulf of Mexico and northward to the Lee County border, and includes part of Hendry County. The basin does not have a major source of surface water for year round water supply. Lake Trafford, in the northern section of the basin, has a drainage area of approximately 30 square miles. The lake is relatively small (2.3 square miles) and is not considered a significant source of water storage for the region.

The Gordon and Cocohatchee rivers are the two remnant natural rivers in this basin. Both of these rivers are tidally influenced and connect to the extensive canal system within this basin. This basin flows into the Gulf of Mexico near the Ten Thousand Islands. This canal system, operated and managed by the Big Cypress Basin Board (BCBB), serves primarily as a drainage network. Since 1981, the BCBB has retrofitted many old weirs and constructed new water control structures in these canals to prevent overdrainage of the basin. Since the primary source of water for this system is rainfall, the canals have little or no flow during the dry season.

The West Collier Basin has extensive wetland systems. These systems include the Corkscrew Regional Ecosystem Watershed (CREW), Fakahatchee Strand State Preserve, and the Collier-Seminole State Park (**Plates 1 and 4**). An assessment of the CREW area was completed in September 1993. The assessment indicated that wellfield development and/or aquifer augmentation could affect the wetlands within the CREW boundaries. The assessment recommends detailed three-dimensional analyses prior to any proposed wellfield development.

East Collier Basin

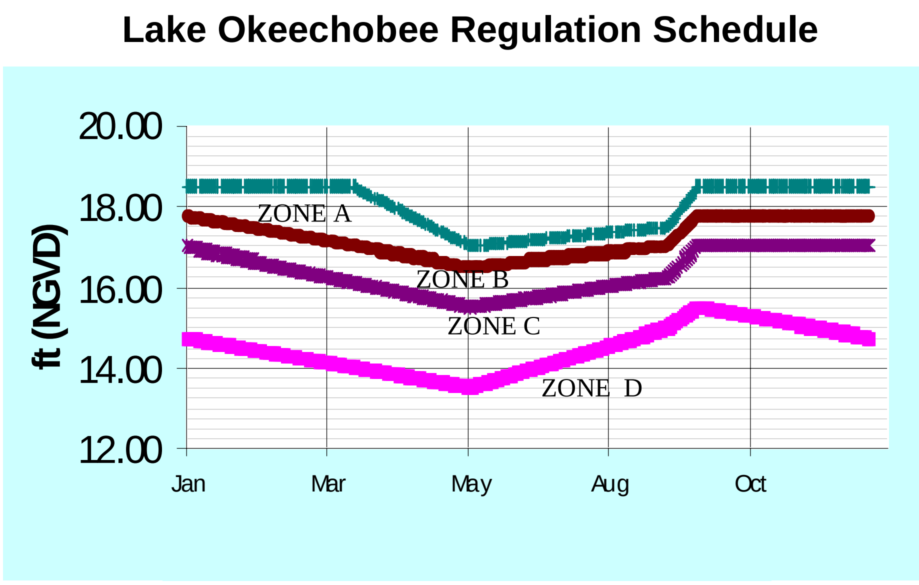
The East Collier Basin extends from State Road 29 eastward to the LWC Planning Area boundary, north approximately three miles into southern Hendry County, and south into Monroe County. Sheetflow from this basin flows south into the Everglades National Park and the Gulf of Mexico. The Big Cypress National Preserve forms most of this basin (**Plate 1**). There are no major rivers or major sources of surface water for year-round water supply use in this basin.

Lake Okeechobee

Lake Okeechobee is managed as a multipurpose freshwater resource in the C&SF Project. The primary tool for managing high lake water levels is the regulation schedule. This schedule defines the specific discharges that will be made to control excessive accumulation of water to protect the lake's levee system. The schedule varies seasonally to best meet the objectives of the C&SF Project. A number of lake regulation schedules have been adopted since the construction of the C&SF Project (see Trimble and Marban, 1988). In 1978, the USACE adopted the “15.5-17.5” schedule, in which regulatory releases were made if lake stage exceeded 15.5-17.5 feet NGVD. A pulse release program was demonstrated in 1991, and formally adopted in 1994, to reduce the likelihood of making large freshwater releases to the St. Lucie and Caloosahatchee River estuaries. This schedule is commonly referred to as “Run 25" and is currently in place (**Figure 8**).

Run 25 contains three management zones: Zone C, Zone B and Zone A, as identified by individual lines of zones shown in **Figure 8**. Below Zone C is three “Pulse Release Zones,” identified as Level I, II, and III, which correspond to specific discharge volumes developed for the Caloosahatchee River and St. Lucie River estuaries, as shown in **Table 5**. When the lake stage falls below the Zone C line, no regulatory discharges are required. When lake stages reach any Zone (not just A, B, or C) releases of water are made by the USACE in accordance with the parameters shown below. In Zone A, the USACE has the authority to make maximum discharges to all outlets in an effort to reduce lake levels to protect the structural integrity of the levee system from a major storm.

The large-scale discharges required in Zone A, Zone B and Zone C are damaging to the downstream estuarine systems. The Pulse Release Zone D was developed to provide



Releases Through Lake Okeechobee Outlets

Zone	Agricultural Canals to WCAs	Caloosahatchee River at S-77		St Lucie Canal at S-80	
A	Pump Maximum Practicable	Up to Maximum Capacity		Up to Maximum Capacity	
B	Maximum Practicable Releases	***Normal to Very Wet:*** Up to 6,500 cfs	***Dry:*** Up to Maximum Pulse Release	***Normal to Very Wet:*** Up to 3,500 cfs	***Dry:*** Up to Maximum Pulse Release
C	Maximum Practicable Releases	***Wet to Very Wet:*** Up to 4,500 cfs ***Normal:*** Up to Maximum Pulse Release	***Dry:*** None	***Wet to Very Wet:*** Up to 2,500 cfs ***Normal:*** Up to Maximum Pulse Release	***Dry:*** None
D	As needed to minimize adverse impacts to littoral zone; no adverse impacts to the Everglades	***Very Wet:*** Up to Maximum Pulse Release	***Otherwise:*** None	***Very Wet:*** Up to Maximum Pulse Release	***Otherwise:*** None

Figure 8. Lake Okeechobee Regulation Schedule.

Table 5. Pulse Release Schedules for the St. Lucie and Caloosahatchee River Estuaries and their Effect on Lake Okeechobee Water Levels.

Day	Daily Discharge Rate (cubic feet per second)					
	St. Lucie Level I	**St. Lucie Level II**	**St. Lucie Level III**	**Caloosa. Level I**	**Caloosa. Level II**	**Caloosa. Level III**
1	1,200	1,500	1,800	1,000	1,500	2,000
2	1,600	2,000	2,400	2,800	4,200	5,500
3	1,400	1,800	2,100	3,300	5,000	6,500
4	1,000	1,200	1,500	2,400	3,800	5,000
5	700	900	1,000	2,000	3,000	4,000
6	600	700	900	1,500	2,200	3,000
7	400	500	600	1,200	1,500	2,000
8	400	500	600	800	800	1,000
9	0	400	400	500	500	500
10	0	0	400	500	500	500
Acre Feet per Pulse and Correlating Lake Level Fluctuations						
AF per pulse	14,476	18,839	23,201	31,728	45,609	59,490
Impact on lake (feet)	0.03	0.04	0.05	0.07	0.10	0.13

Source: SFWMD, 1993, Lake Okeechobee SWIM Plan.

a buffer or safety factor for making early or pulsed releases of lake water to downstream estuaries. These release patterns mimic the hydrograph associated with a rainfall event that would normally occur in an upstream watershed of the estuary. This release concept allows the estuary to absorb the freshwater release without drastic or long-term salinity fluctuations.

Although Lake Okeechobee is a potentially large source of water, there are competing users of this water elsewhere within the Lake Okeechobee Service Area, as well as the Upper East Coast and Lower East Coast planning areas. During periods of water shortage in the lake, water supply allocations are determined through procedures described in the Lake Okeechobee Supply-Side Management Plan. This plan states that the amount of water available for use during any period is a function of the anticipated rainfall, lake evaporation, and water demands for the balance of the dry season in relation to the amount of water currently in storage.

Water availability from the lake is calculated on a weekly basis, along with a provision which allows users to borrow from their future supply to supplement existing shortfalls. The borrowing provision places the decision of risk with the user and can significantly affect the distribution of benefits among users because the amount of water borrowed is mathematically subtracted from future allocations. The Lake Okeechobee Supply-Side Management Plan is implemented if the projected lake stage falls below 11.0 feet NGVD at the end of the dry season, or below 13.5 feet NGVD at the end of the wet season (**Figure 9**).

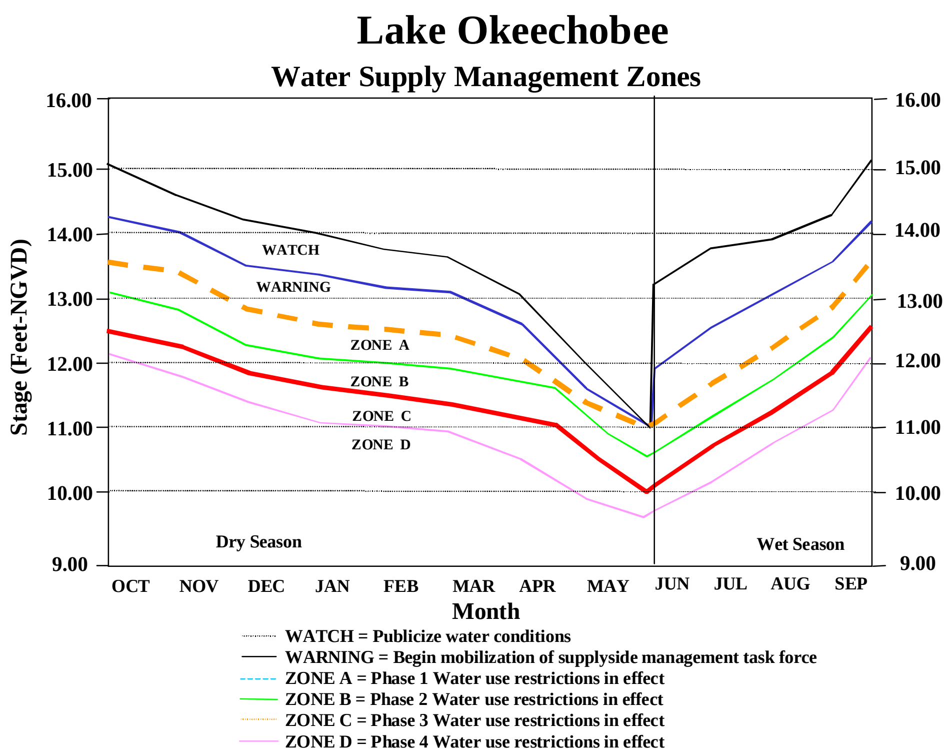


Figure 9. Lake Okeechobee Supply-Side Management Plan.

DRAINAGE DISTRICTS

Chapter 298, Florida Statutes governs local drainage districts **(Figure 8)**. These 298 districts are empowered to develop and implement a plan for draining and reclaiming the lands within their jurisdiction. The 298 districts have the power to construct and maintain canals, divert flow of water, construct and connect works to canals or natural watercourses, and construct pumping stations. They may also enter into contracts, adopt rules, collect fees, and hold, control, acquire or condemn land and easements for the purpose of construction and maintenance.

The District's past practice has been to issue consumptive use permits to the 298 districts for surface water use, while not requiring individual permits for users within these districts. Some 298 districts, however, may not have received a consumptive use permit; in these cases individual permits would be issued. The individual 298 district must still meet all conditions for issuance of a permit. The permit should indicate how water will be allocated, and should list the type and quantity of water use for each user.

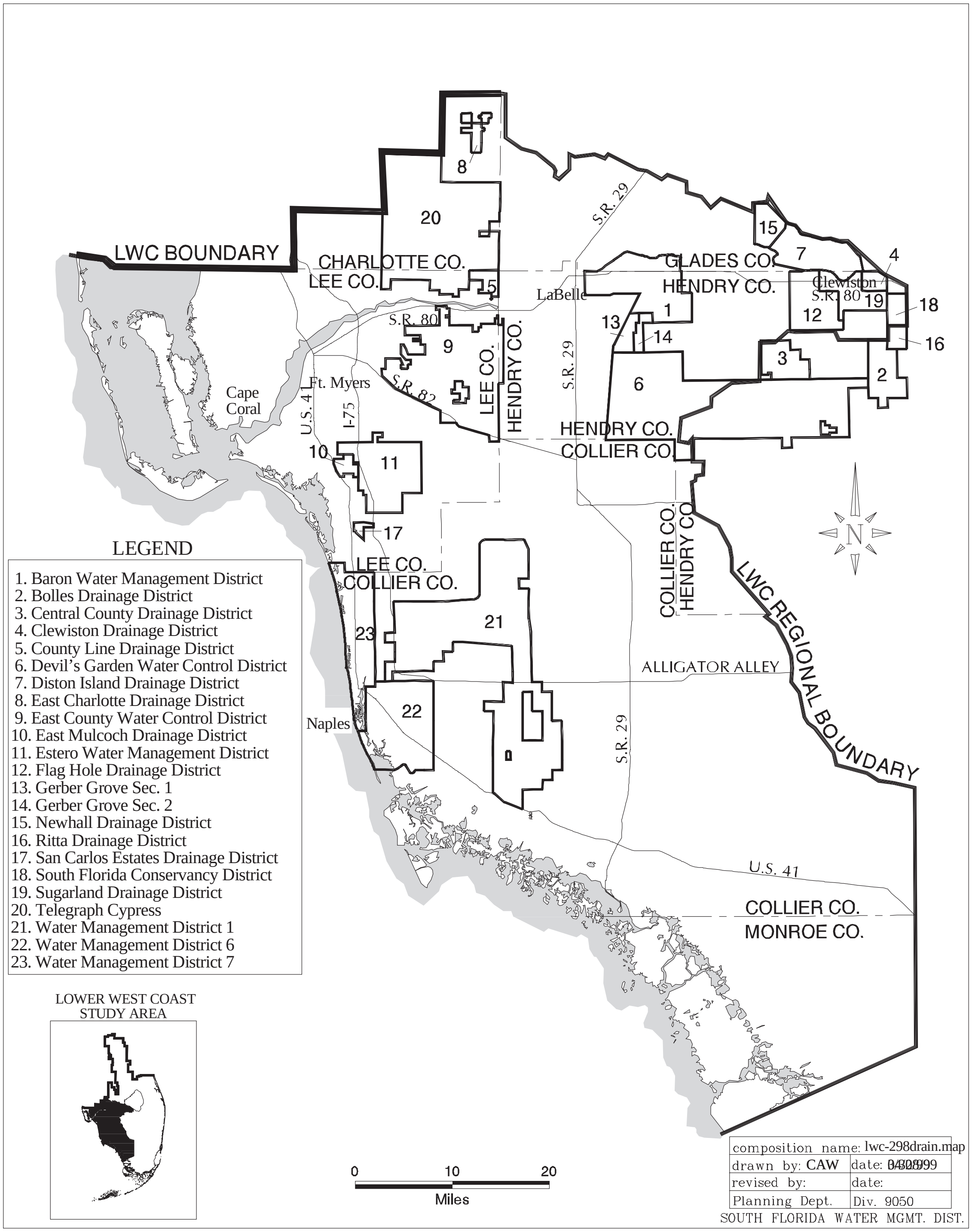


Figure 10. 298 Drainage Districts in the Lower West Coast Planning Area.

GROUND WATER RESOURCES

The hydrogeology of South Florida is diverse. It includes aquifers which are confined (in which ground water is under greater than atmospheric pressure and isolated from vertical recharge), semi-confined (having some vertical recharge), and unconfined (ground water is at atmospheric pressure and water levels correspond to the water table). Within an individual aquifer, hydraulic properties and water quality may vary both vertically and horizontally. Because of this diversity, ground water supply potential varies greatly from one place to another. It is the purpose of this section to identify the aquifers in the region, and describe their current usage and water producing capability.

The three major aquifer systems; the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS) and the Floridan Aquifer System (FAS), are summarized in **Tables 6 - 10** for Charlotte, Collier, Glades, Hendry, and Lee counties. Appendix C includes a collection of ground water resources graphics. A stratigraphic cross section, and maps showing the elevation and thickness of each of the hydrogeologic units are provided in Appendix C. Information on ambient ground water quality, contamination sites, and saltwater intrusion is provided in Appendix G.

Table 6. Ground Water Systems in Charlotte County.

Aquifer System	Aquifer Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	0-70	Aquifer productivity is variable. Most wells yield less than 50 gpm, but can range as high as 600-700 gpm in wells tapping the Caloosahatchee marl in southeastern Charlotte County.
Intermediate Aquifer System	Sandstone Aquifer/ Mid-Hawthorn Aquifer	70-260	Important source of water for domestic and irrigation wells in southeastern Charlotte County.
Floridan Aquifer System	Lower Hawthorn Aquifer/ Upper Tampa Aquifer	150-300	Widely used for irrigation, but requires desalination treatment for potable use. Most productive zone lies at the contact between the Lower Hawthorn and Tampa formations.
	Suwannee Aquifer	200-300	Most productive aquifers in Charlotte County, but water requires desalination treatment for all uses. Water quality deteriorates from east to west.
	Ocala Group	200-300	

Table 7. Ground Water Systems in Collier County.

Aquifer System	Aquifer Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	20-100	The water table aquifer and the lower Tamiami aquifer are the most productive aquifers in the county. Yield High quality water except for isolated areas with high iron content. Potential for saltwater intrusion in coastal areas. In areas where the confining zone is absent, there is direct hydraulic connection of the Lower Tamiami and the water table aquifer.
	Lower Tamiami Aquifer	40-180	
Intermediate Aquifer System	Sandstone Aquifer	0-110	Yields large amounts of water in the northern portion of the county, but is absent south of Alligator Alley. Suitable for mostly agricultural uses.
	Mid-Hawthorn Aquifer	60-120	Aquifer is low yielding and produces poor quality water. Suitable only for microirrigation uses.
Floridan Aquifer System	Lower Hawthorn/ Suwannee Aquifer	Insufficient Data	Capable of high yields but requires desalination treatment. Some zones may be suitable for use in aquifer storage and recovery.

Table 8. Ground Water Systems in Glades County.

Aquifer System	Aquifer Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	20-100	Adequate in most areas for private domestic supply, but water quality is poor near Lake Okeechobee.
Intermediate Aquifer System	Sandstone Aquifer	90-230	Adequate in most areas for private domestic supply and to small to moderate irrigation
Floridan Aquifer System	Lower Hawthorn/ Suwannee Aquifer	500-1,400	Aquifer is under flowing artesian conditions throughout Glades County. The aquifer is highly productive. Productivity generally increases with depth: however, chloride, TDS, and sulfate concentrations increase with depth throughout the county. Aquifer is unsuitable for irrigation in southern Glades County.

Table 9. Ground Water Systems in Hendry County.

Aquifer System	Aquifer Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	0-100	Extensive throughout Hendry County. Productivity varies widely. Heavily used in isolated areas where other aquifers do not exist, or are low yielding.
	Lower Tamiami Aquifer	0-135	Most productive aquifer in Hendry County. Heavily used in the southeast county area. Thin or nonexistent in the northern and western portions of the county.
Intermediate Aquifer System	Sandstone Aquifer	0-120	Occurs in western Hendry County. Heavily used in areas where the lower Tamiami is thin or nonexistent. Moderately productive, water nonpotable in many areas.
	Mid-Hawthorn Aquifer	Insufficient data	Limited occurrence in Hendry County. Very low productivity; water quality not suitable for most irrigation uses.
Floridan Aquifer System	Lower Hawthorn/ Suwannee Aquifer	No Data	Little is known about the Floridan in Hendry County. It is believed to be capable of producing large volumes of water through flowing wells. Water is not suitable for irrigation.

Table 10. Ground Water Systems in Lee County.

Aquifer System	Aquifer Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	20-80	Yields moderate amounts of high quality water but already heavily allocated. Susceptible to saltwater intrusion near the coast.
	Lower Tamiami Aquifer	0-140	Absent from northern Lee County. Where present, yields moderate to large amounts of high quality water. The coast is susceptible to saltwater intrusion.
Intermediate Aquifer System	Sandstone Aquifer	0-110	Yields large quantities of good quality water in south central Lee County, but is absent in the north and east.
	Mid-Hawthorn Aquifer	40-120	Yields small quantities of good quality water in Cape Coral and north of C-43. Elsewhere suitable only for microirrigation uses
Floridan Aquifer System	Lower Hawthorn/ Suwannee Aquifer	Insufficient data	Capable of high yields but requires desalination treatment. Some zones may be suited for aquifer storage and recovery.

Surficial Aquifer System

The SAS may be divided into two aquifers, the water table and lower Tamiami, which are separated by leaky confining beds over much of the area. In northern Lee County, where the confining beds are absent or insignificant, the lower Tamiami is not a separate aquifer but part of the unconfined water table aquifer. The thickness of the SAS ranges from more than 200 feet in central and southern Collier County to four feet southwest of LaBelle in Hendry County. The SAS is further described by Bower et al., 1990, Smith and Adams, 1988; and Knapp et al., 1986.

The water table aquifer includes all sediments from land surface to the top of the Tamiami confining beds. Within Lee County, four major public water supply wellfields, all located in areas where the confining beds are absent, pump water from the water table aquifer. These are Lee County Utilities (Corkscrew Wellfield and Green Meadows Wellfield), Gulf Utilities, and the city of Fort Myers. The aquifer also furnishes irrigation water for many uses, including vegetables, berries, melons, nurseries, and landscape irrigation. In Hendry County, the water table aquifer is generally used only where no suitable alternative is available, though it may yield copious quantities of water in isolated areas. It produces good quality water, except in areas near LaBelle and parts of the coast, that have high concentrations of chlorides and dissolved solids, and isolated areas with high iron concentrations.

The lower Tamiami is the most prolific aquifer in Hendry and Collier counties. The lower Tamiami aquifer supplies water to Bonita Springs, Collier County, city of Naples, Immokalee, and North Naples, as well as many domestic self-suppliers and landscape and agricultural irrigation wells. Because of the large demands on the aquifer, it has been endangered by saltwater intrusion on the coast, and is frequently included in water shortage declarations.

Intermediate Aquifer System

The IAS consists of five zones of alternating confining and producing units which are further described in other District Publications (Wedderburn et al., 1982; Smith and Adams, 1988; and Knapp et al., 1984). The producing zones, which comprise the IAS, include the Sandstone and mid-Hawthorn aquifers.

The Sandstone aquifer has variable thickness. It averages over 100 feet near Immokalee and portions of central Lee County, but pinches out to the south around Alligator Alley, to the northwest in Cape Coral, and to the east in the middle of Hendry County.

The productivity of the Sandstone aquifer is highly variable. It provides all of the water withdrawn by the Lehigh Acres Public Water Supply Wellfield and a portion of that withdrawn by the Lee County Corkscrew and Green Meadows wellfields. In western Hendry County, where the lower Tamiami aquifer is absent, it is an important source of water for agricultural irrigation, but is not capable of supporting large-scale agricultural operations in most areas. Only marginally acceptable for potable uses in Hendry and Collier counties, water from the Sandstone aquifer is suitable for irrigation purposes throughout its extent, with the exception of the LaBelle area, where it has been contaminated by flowing Floridan wells.

Although present throughout the LWC Planning Area, the mid-Hawthorn Aquifer is not always productive. Its thickness is variable and relatively thin (it rarely exceeds 80 feet). This variability, combined with the presence of interbedded low permeability layers, results in low productivity of the aquifer. In addition to low productivity, the aquifer experiences degradation in water quality as it dips to the south and east, yielding only saline water in much of the LWC Planning Area.

The mid-Hawthorn aquifer formerly provided water for the city of Cape Coral and the Greater Pine Island water utilities. However, its limited water-producing characteristics made it an unreliable source. Both utilities have been forced to develop other sources. It is also used for domestic self-supply in those areas of Cape Coral not served by city water and for small water utilities north of the Caloosahatchee River. Elsewhere the aquifer is used only occasionally for agricultural irrigation.

Floridan Aquifer System

The FAS, which underlies all of Florida and portions of southern Georgia and Alabama, contains several distinct producing zones which are described by Wedderburn et al., 1982. Although it is the principal source of water in Central Florida, the FAS yields only nonpotable water throughout most of the LWC Planning Area. The quality of water in the FAS deteriorates southward, increasing in hardness and salinity. Salinity also increases with depth, making the deeper producing zones less suitable for development than those near the top of the system.

Developments in desalination technology have made treatment of water from the upper portion of the FAS feasible where chloride concentrations are not prohibitively high. The most productive zones are the lower Hawthorn and Suwannee aquifers. Currently, several utilities including the city of Cape Coral, Greater Pine Island, Collier County, Marco Island Utilities, and Island Water Association (Sanibel), obtain water from the lower Hawthorn or Suwannee aquifers. Elsewhere, the aquifers supply only a few agricultural irrigation wells. Improvements in desalination treatment technology will make development of these aquifers increasingly feasible; continuing increases in the demand for water in the LWC Planning Area, moreover, will make it necessary. Portions of the producing zones may also have potential for use in ASR projects.

In the deeper producing zones of the FAS, there are areas of extremely high transmissivity, known as “boulder zones.” Although they are not used as supply sources within the LWC Planning Area due to the high salinity and mineral content, these formations may serve other purposes. Some areas of the boulder zones have been used as disposal areas for treated wastewater effluent or residual brines from the desalination process.

SURFACE WATER/GROUND WATER RELATIONSHIPS

In the preceding sections, surface water and ground water resources have been addressed as separate entities. In many ways, however, they are highly interdependent. The construction and operation of surface water management systems affect the quantity and distribution of recharge to the SAS. Surface water management systems within the LWC Planning Area function primarily as aquifer drains, since the ground water levels generally exceed the surface water elevations within the LWC Planning Area. The Caloosahatchee River and the Gulf of Mexico act as regional ground water discharge points (Wedderburn et al., 1982). Ground water seepage represents 47 percent of the inflow to the Caloosahatchee River. During the wet season, after a rain event some recharge to the SAS may occur from drainage canals, small lakes such as Lake Trafford and low lying areas (Knapp, 1986; Smith and Adams, 1988). Surface water management systems also impact aquifer recharge by diverting rainfall from an area before it has time to percolate down to the water table. Once diverted, this water may contribute to aquifer recharge elsewhere in the system, supply a downstream consumptive use, or it may be lost to evapotranspiration (ET) or discharged to tide.

The Sandstone aquifer comes into direct contact with the SAS northeast of Immokalee (Smith and Adams, 1988). In those areas the Sandstone aquifer responds almost immediately to rain events, but the aquifer is receiving the water through the SAS and it does not have direct contact with surface water systems. The remainder of the IAS is not hydraulically connected to surface water.

The FAS is not hydraulically connected to surface water within the LWC Planning Area. FAS water is usually diluted with surface water to achieve an acceptable quality for agricultural irrigation. Consequently, surface water availability for dilution purposes can be a limiting factor on the use of FAS water.